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Correlating climate and longleaf pine cone crops: Is there a connection?

Neil Pederson (Marshall Woods Consulting, 3 William St., Sparkill, NY 10976)
John S. Kush (School of Forestry, 108 M. White Smith Hall, Auburn University, AL 36849)
Ralph S. Meldahl (School of Forestry, 108 M. White Smith Hall, Auburn University, AL 36849)

ABSTRACT: The physiological development of longleaf pine seed from flower through cone to seed is a lengthy process, extending over three calendar years. The duration of this process may be the main reason why longleaf pine produces infrequent seed crops with which to regenerate itself. Adequate crops occur every 5-7 years, on average, causing problems for those interested in natural regeneration of longleaf pine. Longleaf pine seed crops have been monitored on the Escambia Experimental Forest in Brewton, AL since 1955. The period from the mid-1960's to the mid-1980s produced few cone crops considered satisfactory for longleaf pine regeneration. Since the mid-1980's, adequate crops have become more frequent with the 1996 crop as one of the largest on record. Using weather data from the National Climatic Data Center and cone crop data from the Escambia Experimental Forest, the relationship between longleaf pine cone production and climate will be examined.

INTRODUCTION

One of the major concerns in longleaf pine management is seed production. Compared to the other southern pines, longleaf is a sporadic seed producer. Wahlenberg (1946) noted that good seed crops might occur every 5 to 7 years. Maki (1952) reported heavy seed crops might occur over much of the longleaf range once in 8 to 10 years. The 1996 longleaf seed crop was one of those "much-anticipated" region-wide seed crops. Whether the interest is natural or artificial regeneration, it is important to know when to expect a bountiful seed crop.

Development of Longleaf Pine Seeds

The visual development of longleaf pine seed extends into three calendar years. The following is an abbreviated guideline for the longleaf pine seed development process:

Months prior to seedfall and what happens:

27 months - Differentiation between male and female flowers occur; usually July, 2-years prior to seedfall.
22 months - male flowers appear, usually December, 2-years prior to seedfall.
19 months - female flowers appear and pollination occurs, usually February to April, 1-year prior to seedfall.
5 months - fertilization occurs, usually May to June of seedfall year.
Seed ripen and fall between late September and early November.

METHODS

Cone Crop Data

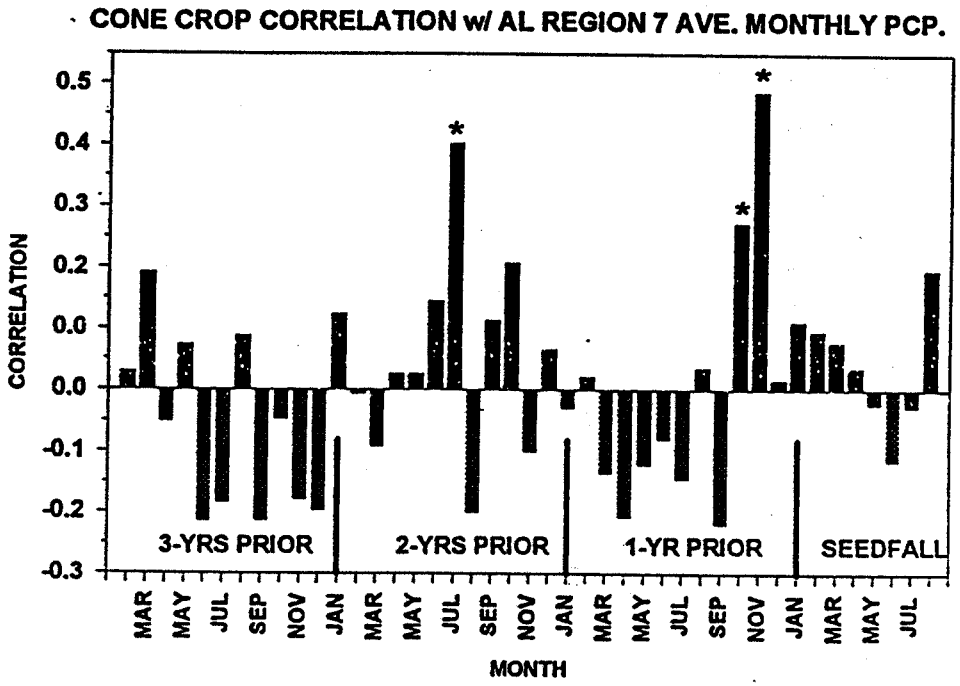
Long-term records of longleaf pine cone production were obtained from natural regeneration trials conducted on the Escambia Experimental Forest. The cone counts were conducted in shelterwood and seed-tree stands that were nearing saw-log rotation. Annual springtime binocular counts of female flowers and conelets were made using the method described by Croker (1971).

Climate Data

Climate data was obtained from the National Climatic Data Center (NCDC) in Asheville, NC. These data included temperature and precipitation data from the National Weather Service station in Brewton and the regional average data for Alabama Climatic Division 7, of which Brewton is located. Regional data tends to reduce the noise of individual station data (Blasing et al. 1981). This was employed to improve the statistical relationship between cone crops and climate. Growing season temperature and precipitation data were used with growing season was defined as the months of March through October.

RESULTS

The following relationships were observed from correlating longleaf pine cone crops and precipitation.



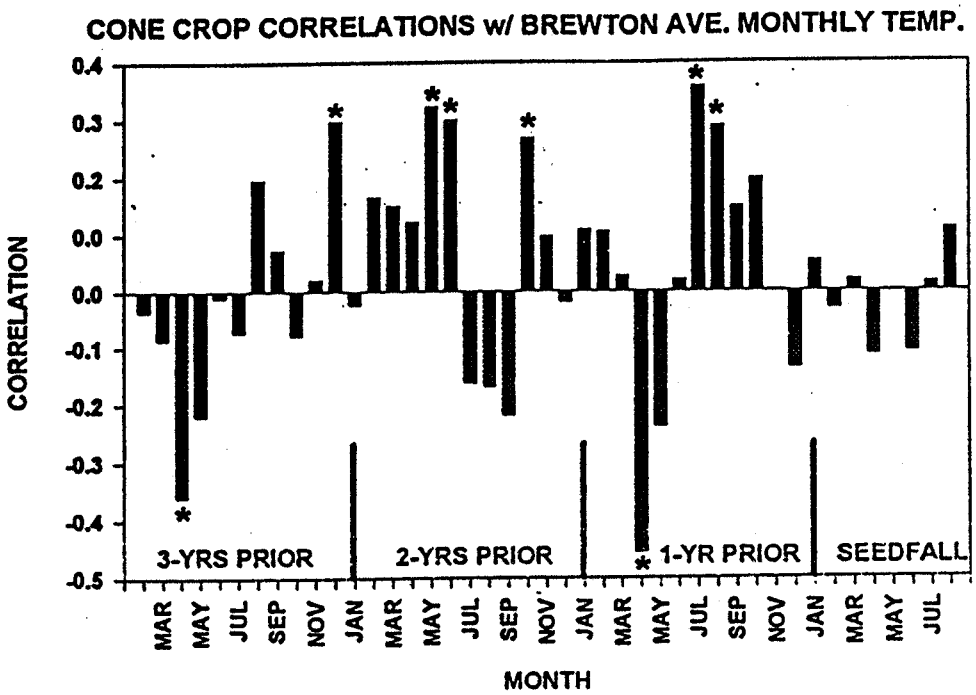
Two-years prior to seedfall

Generally, a wet summer and early fall related to crop production.
A wet July is significantly correlated to cone crops.
⇒ Does a moist growing season help set a fertile {strong?} cone bud?

One-year prior to seedfall
A moist October and November are significantly correlated to cone crops.
A wet fall fosters a good cone crop.
⇒ Does late growing season rainfall allow luxury nutrient uptake to feed cones?

Year of seedfall
No strong precipitation trends seem to be related to cone crops.
⇒ Are cone crops determined before final year of ripening?

The following relationships were observed from correlating longleaf pine cone crops and temperature.



<u>Three years prior to seedfall</u>
Warm springs diminish, while a mild December promotes cone crop production.
A warm April is significant and negatively correlated, while December is significant and positively correlated to cone crops.
⇒ Do warm springs reduce potency {health} of flower bud?
⇒ Does a warm December increase potency {health} of flower bud?

<u>Two-years prior to seedfall</u>
Warm winter through early summer and late fall related to crop production.
May, June and October are significant and positively correlated to cone crops.
⇒ Do mild winters protect flower buds?
⇒ Do warm springs aid in pollen production and pollination?
⇒ Does a warm, late fall help set a fertile {strong?} cone bud?

<u>One-year prior to seedfall</u>
A cool late spring, warm summer and early fall fosters a good cone crop.
A hot April is significant and negatively correlated, while July and August are significantly and positive correlated to cone crops.
⇒ Does a warm, late spring injure developing cones?
⇒ Does a warm, late growing season allow luxury nutrient uptake to feed cones?

<u>Seedfall year</u>
Temperature does not appear to effect cone production.
⇒ Are cone crops determined before final year of ripening?

Checklist of climate for the 1996 bumper cone crop

	1996 CROP YEAR			
	TEMPERATURE		PRECIPITATION	
	Correlation	Actual	Correlation	Actual
3 yrs prior	cool April + warm December	cool, + cool	NA	
2 yrs prior	warm May warm June + warm October	cool, warm, warm	wet July	wet
1 yr prior	cool April warm July + warm August	cool, warm, warm	wet October + November	wet + wet

Checklist of climate for the 1992 bust cone crop

	1992 CROP YEAR			
	TEMPERATURE		PRECIPITATION	
	Correlation	Actual	Correlation	Actual
3 yrs prior	cool April + warm December	cool, cool	NA	
2 yrs prior	warm May June + October	cool, cool, warm	wet July	dry
1 yr prior	cool April warm July + August	warm, warm, warm	wet October + November	dry + wet

Of the 11 significant months required for cone crop development, nine were met in 1996 while only four were met in 1992. Although not every significant month is needed for cone crop development, certain trends seem important. The dry summer 2-years prior and autumn 1-year prior severely limited the 1992 crop. The slightly above average summer and autumn 2-years prior and summer 1-year prior aided the 1996 crop despite a cool winter 3-years prior. Severity must be taken into consideration. If the winter 3-years prior had been severe, like the small crop of 1972, 1996's crop might not have developed.

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